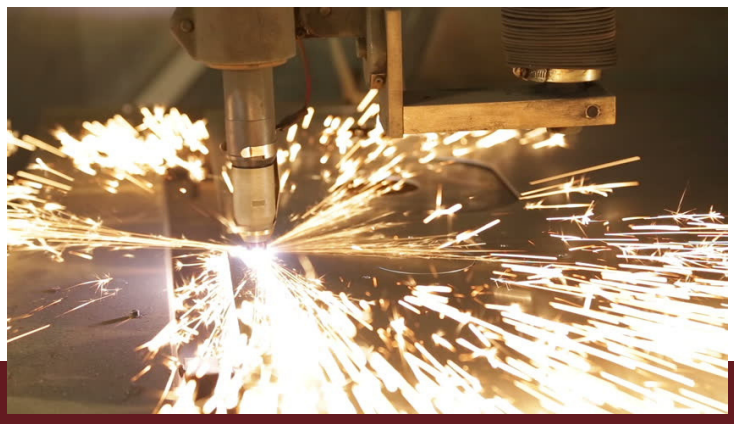
ARRELIC INSIGHTS

DEFECT ELIMINATION

Adopting defect elimination

In this article, we are going to discuss on adopting a defect elimination and condition-based maintenance program to achieve the lowest lifecycle costs. We will start with an overview of the maintenance practices and then take a quick look at the predictability of the failure of rotating machinery if we know how they fail we can better choose the most appropriate maintenance strategy and understand how to avoid failure then we will take a more detailed look at defect elimination doing everything possible to avoid failure from the design and procurement process all the way through to the operation of the machine and adding QA and QC checks and condition monitoring and finally we will propose a roadmap to reliability the steps you can take to implement a successful reliability improvement program in your plants but first we're going to look at maintenance practices we all know that machines are going to fail at some point hopefully we'll get lots of life out of a machine but we do have to deal with the fact that they may fail so what can we do about it the first and easiest is reactive maintenance or runs a failure maintenance and that can be a very costly and unsafe strategy but if you have an asset criticality ranking you will determine that some machines should be maintained in that way in other words let them fail because it is not economically justifiable to do anything to avoid the failure sure if you hear them making a strange sound you can stop the machine but performing any predictive maintenance or anything else really isn't necessary the next alternative is to use preventive maintenance performing maintenance actions to prevent some the component from failing so taking pre-emptive action so for example we can have a shutdown we can replace bearings seals and other components and perform other intrusive work and inspections with the idea that we will not allow the machines to fail in between time and we will breathe new life into the machine. Unfortunately, in many cases we do quite the opposite the machine might have been in very good condition we open it, make a change and we introduce a problem so that introduces predictive maintenance or condition-based maintenance the idea is we will take measurements on the machines and perform small tests to determine what the current condition of that machine or acid is and if we use those technologies properly we can

learn potentially months in advance if there's going to be a problem and that it may fail and with that information we can then look at our maintenance strategy and our maintenance schedule I should say and demands on production and the availability of parts and all those sorts of things to determine when is the best time to perform that maintenance and we'll explore that in a little more detail in a moment when we look at the predictability of failure but so far in particular with reactive maintenance and predictive maintenance all we are doing is reacting to problems that come up sure with predictive maintenance we'll perform tests and get a heads up and take the appropriate action but often we're reacting to problems that should never exist and that's where we introduce precision maintenance. Now we are going to change the way we work with the machines so whether it's installing the bearings, performing lubrication, doing our alignment and balancing performing steps that are likely door that will increase the life on that machine we will improve the reliability of the machine because we avoid introducing the sorts of problems that cause the machine to fail and if we take that to the all from a degree we have defect elimination defect elimination is is a case of standing back and saying what happens through the entire life of



"More maintenance is not the answer—it only adds more expense without the benefit of defect elimination."

the asset from the time it's on the drawing board and it goes through the procurement process and the transportation the storage the installation and the operation of that asset and we could go all the way through to the disposal of the asset but from a defect elimination point of view we are looking at every single opportunity there is to introduce a defect which will result in premature failure and doing everything possible to eliminate those defects and that is the way to achieve the highest level of reliability. So how do we make these stratergies work and particularly how do we make defect elimination work so what is it we know about the failure modes of rotating machinery if I was to ask you how long the bearings normally last and when do they fail commonly it's believed that you will get a certain life out of a bearing that is fairly predictable and then it will fail and if we took 30 bearings from different applications and so on but if they're all properly specified for those applications then you might expect that they will all fail at around the same sort of time so if we were planning our maintenance action and this is really what this yellow

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bar you know at what point do we perform our maintenance action. You know preventative maintenance replacing the bearing, for example, well what we want to do is to do it as late as possible so that we don't have any failures you know if we leave it any longer then that one's going to fail. So we just need to come up with a with a period of months that if we replace those bearings then we restart its life if you well that would be fantastic if only it were true in actual studies from plants and just in laboratory with bearings being run under a certain load and set of conditions the response ISM more like this it's very random. What we mean, is these are actual test results so you can see that some did not last very long and others lasted for a long time. So if we make that same assessment as far as when is the appropriate time to perform preventive maintenance replace the bearing regardless of its actual condition just based on its perceived condition we've got a problem here, because you know if we chose this particular interval then we see we still get failures we catch some just at the right time and others we waste because these bearings would have lasted a lot longer we would have achieved a much longer life from those bearings. But we pulled the mouth and replace them and when we did that we might have introduced problems such that now they don't take very long to fail at all so that's the reality of the situation. Particularly in a plant that hasn't really taken a good hard look at how they can improve reliability and eliminate these sources of defects and look there are lots of studies and it's not the real point of this article but the studies indicated that approximately 90% of your rotating machinery will have random failures we cannot predict without using condition monitoring technologies. What the life will be there may be an infant mortality period but then at some point it's going to fail during its lifetime it could be ten weeks, it could be ten years some we have this running sort of process with the infant mortality. In other cases that's just random all the way through in other cases, we may have a period where there is less likelihood of failure but that's 90% now made very slightly in your particular industry but that's what you've got to keep in mind. That's why just using preventive maintenance is not the solution the other thing we have to keep in mind is the way rotating machinery fail and what sort of notice they provide to us so in this case we're looking at a graph which is you know time along here you know months passing by and the condition so while it's up high it's indicating that the condition is good we can keep operating that machine.

So if we live our little animation go along we can see its defect-free it's running along and it's reliable and we get in good trouble-free life and obviously, we want that to happen for as long as possible. But at some point in time the defect is initiated and that could be because the machine was not lubricated properly operated properly an original installation problem resulted in this problem there was misalignment there was unbalance there are so many reasons why bearings fail and therefore the defect might be introduced at any time anywhere along its life so we get to the point in time where something is causing it to begin to fail and for a certain period.

The problem hasn't degraded that much that the condition has really suffered but we get to a point in time that you know in the text we call the potential failure from now on the fact that the defect has been initiated it will be detectable. So if we keep watching what's going to happen is with the passage of time the conditions going to get worse and worse and worse so the conditions getting worse it's coming down off the y-axis. But at certain times certain condition monitoring techniques will enable us to detect the problem but what you can see there is that as it moves closer and closer to its ultimate catastrophic failure there is a time perhaps before the ultimate catastrophic failure where we can say that it is functionally failed it's no longer doing the job that we know purchased and installed that machine to do it may not be producing the proper head if it's a pump it may be making a noise which means we have to stop it you know for some reason we can no longer use the machine so we have this period of time between the potential failure where afterwards we could detect that there's a problem and the functional failure you know at that point we don't want to use the machine any longer. So the question is you know how long is that interval and if it's a good healthy interval of a matter of months then we can use technologies and we've indicated some of them there that will indicate to us that the problem exists so what we want to do though is detect it as early as possible. The earlier we detect it the more time we have for planning the lower the risk and the lower the cost associated with the repair. But the longer we leave it and you can see the different technologies now very generously showed that this ultrasound might pick it up you know in this is a lubrication problem vibration detected might detect it at a certain point may be the same point we use oil analysis and these various technologies we don't need to go into in much detail. But the longer we leave it the later we detect it and the later we act the risk goes up the cost goes up the planning time goes down and the situation becomes more and more sort of urgent and reactive until the point where you know it failed and you know the costs are obviously much greater at that time. So that's the thing to keep in mind failures are random but in the vast majority of cases with rotating machinery, we can predict it so the aim is to consider this factor.

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If you have any question or would like further information on Defect Elimination please feel free to contact us.

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